14. *Some new Caddis Flies (Trichoptera) from the Western Cape Province—I.* By K. M. F. Scott, Ph.D., F.R.E.S., Department of Zoology, University of Cape Town. (With six text-figures.)

Summary

A new species, *Petroplax curvicosta* (family Sericostomatidae, genus *Petroplax* Barnard), is described, together with its larva and pupa. The young stages of *P. prionii* Barnard are also described, and a fuller account given of the larva and pupa of *P. caricis* Barnard (briefly described by Barnard, 1934, p. 319). The generic diagnoses of the larvae and pupae are revised, and the wing venation of the imagos discussed. A key to the five known species of *Petroplax* (based on ♂ imagos) is appended, also a series of sketches to facilitate the identification of the females (of which only four are known).

Introduction

During the past three years a survey of the Great Berg River was carried out from the Zoology Department of the University of Cape Town by Mr. A. D. Harrison of the Council for Scientific and Industrial Research. The author was associated with some of this work, and has pleasure in acknowledging grants from the C.S.I.R. (first a Research Assistantship and recently a Senior Bursary) which made this possible and which have enabled her to continue work on some of the animals collected, particularly the Trichoptera and Chironomidae. Grateful thanks are also due to Mr. Harrison for much assistance; to Professor Day of this Department for criticism and advice, and also to Dr. K. H. Barnard for his kindly interest in this work, as well as for the loan of specimens and literature in the South African Museum.

In the course of the survey a considerable amount of caddis material accumulated; this includes many larvae and pupae as well as imagos caught in the vicinity of the river. Several of the caddis appear to be new species; in other cases known species have been correlated by breeding them out from larvae or pupae in the laboratory. The new forms will be described in this and subsequent papers.

Two papers by Dr. K. H. Barnard (1934 and 1940) provide a firm foundation for further studies of South African caddises, and have been used as a basis for the present work. Reference should be made to these papers for a complete bibliography of earlier and contemporary work; also for descriptions

of families, genera and known species and keys, none of which will be repeated here unless they have been altered to cover new species. Barnard's techniques have been used for the denudation of wings and clearing of genitalia, and the same terminology has been used, though in the case of the male genitalia the terms used by Mosely and Kimmins (1953) have been added in parentheses. The wing notation used is also the same: that of Tillyard.

The holotypes of new species will be added to the South African Museum collection, and paratypes will be sent to the British Museum (Natural History) wherever possible.

Genus *Petroplax* Barnard

1934. *Petroplax* Brnrd, *Trans. Roy. Soc. S. Afr.*, vol. XXI, Part 4, p. 316.

Remarks. The new species described, *P. curvicosta*, agrees with the generic characters except in certain aspects of the wing venation. In the generic diagnosis the venation is described as follows: 'In forewing apical forks, 1,2,5, in ♀ also fork 3, i.e. M simple in ♂, forked in ♀. Thyridial cell very long. 1A and 2A in ♂ joining distally near hind margin, in ♀ proximally. No cross vein between Cu2 and 1A in ♀. In hind-wings forks 1,2,5. Discoidal cell open.'

In *P. curvicosta* (fig. 1A, B, C) forks 1 and 2 are present in the ♂ fore-wing, fork 5 is, however, absent as Cu1 does not reach the margin but joins an anastomosis connecting the arculus to M3 + 4. In the ♀ fore-wing forks 1, 2 and 3 are present, and a false 5 between Cu1 and Cu2. Thus M1 and M2 are separate in the ♀ but not in the ♂, and M3 + 4 is present in both sexes. Cu1 is not branched in either sex. The thyridial cell is long, and 1A and 2A join proximally in the ♀, as in the generic diagnosis; in the ♂ however 2A runs into the hind margin midway to the arculus. There is no cross-vein between Cu2 and 1A in the ♀; there are, however, indications of a cross-vein between Cu1 and Cu2 in both ♂ and ♀. In the hind-wing forks 1, 2 and 5 are present in both sexes as in the generic diagnosis, but there are definite indications of the presence of a cross-vein closing the discoidal cell, also of one joining M3 + 4 to Cu1a.

In consequence of these differences a careful examination was made of specimens of *P. prionii* Brnrd and *P. caricis* Brnrd from our collection, as well as specimens kindly loaned by the South African Museum of both these species and of *P. phleophila* Brnrd. It appears from this examination that in the ♂ fore-wing in these species Cu1 and Cu2 do not normally reach the hind margin but, together with 1A, join an anastomosis running from the arculus to M3 + 4; thus only forks 1 and 2 are present. The only other known species of *Petroplax* is *P. anomala* Brnrd, whose venation (Barnard 1940, fig. 12a) is quite different; in it forks 1, 2 and 4 are present, and the base of 3 (M1 and M2 are separate but M2 joins M3 and fails to reach the margin); Cu1 does reach the margin but remains unbranched, so that fork 5 is absent in this species too. In the fore-wing of the known females forks 1,2 and 3 are always present, also a false 5 between Cu1 and Cu2. There is no cross-vein between Cu2 and 1A. In the

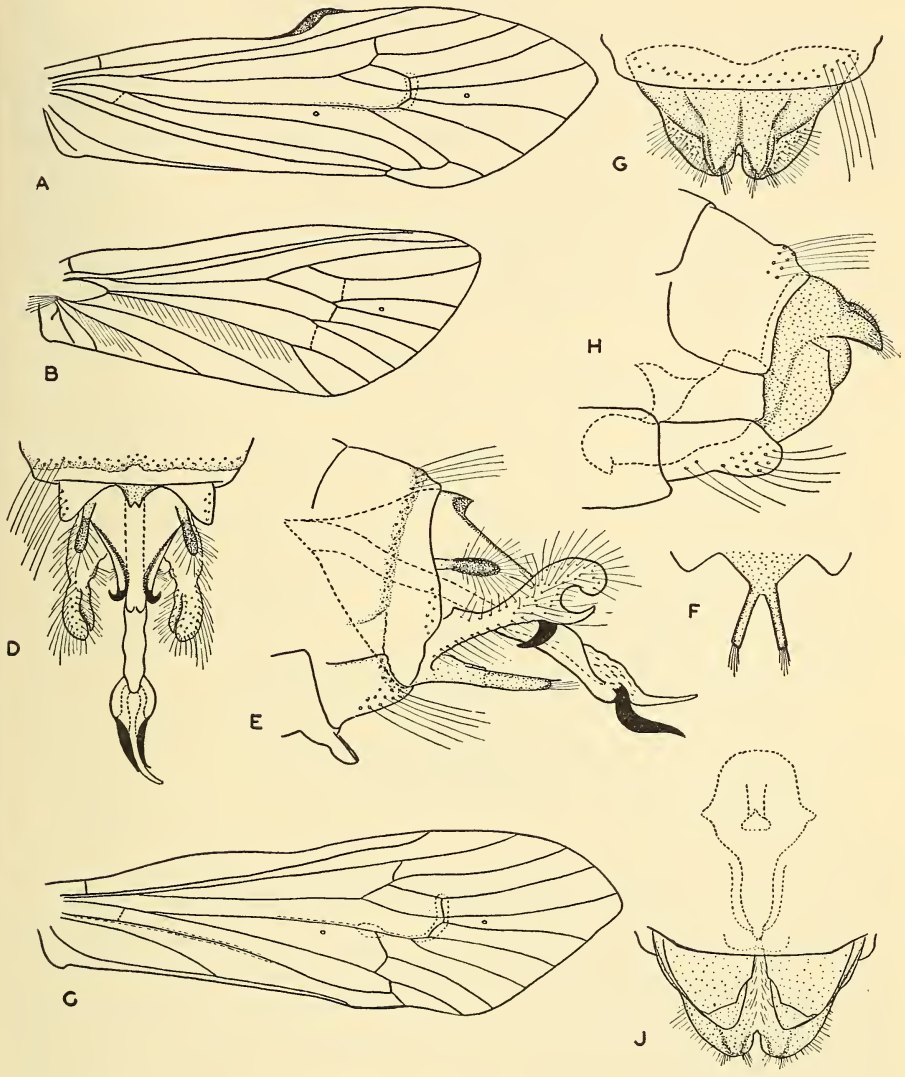

FIG. 1. *Petroplax curvicosta* sp. n., ♂ and ♀ imagos.

A,B, Fore and hind-wings of ♂. C, fore-wing of ♀. D,E, dorsal and lateral views of ♂ genitalia. F, ventral view of 9th sternite of ♂. G,H,J, dorsal, lateral and ventral views of ♀ genitalia.

hind-wing forks 1,2 and 5 are always present, and the discoidal cell is usually closed, either faintly or distinctly; it is, however, open in ♂♂ of *P. caricis* and *P. prionii*. A cross-vein is usually present between Cu1a and M3 + 4.

It is therefore suggested that in the generic diagnosis the description of the wing venation should be amended as follows: 'In fore-wing apical forks 1 and 2 always present, in ♀ also fork 3 and a false 5. Thyridial cell very long. 1A and 2A in ♀ join proximally, in ♂ 2A may join 1A distally or may run into margin before reaching arculus. No cross-vein between Cu2 and 1A in ♀. In hind-wing forks 1,2,5. Discoidal cell may be open or closed in ♂ but is closed in ♀.'

In examining the specimens it was noticed that a pair of eversible membranous processes occurs on the face of the ♂, between the maxillary palps, in *P. prionii*, *P. phleophila* and *P. caricis*. These were not seen in *P. curvicosta*, but may possibly be present though not everted in the three males available.

Key to species of Petroplax (♂♂)

1. Bend in fore-wing; fur-like sensory patch on basal joint of antenna; androconia absent: P. *curvicosta* sp. n.
   No bend in fore-wing; no fur-like sensory patch on antenna; androconia present or absent: . . . . 2.
2. Cu2 and 1A suppressed in fore-wing; Cu1 reaches margin; large patch of androconia. *P. anomala* Barnard.
   Cu2 and 1A present in fore-wing (though Cu1 and Cu2 do not usually reach the margin) . . . . 3.
3. Upper penis cover short, not deeply cleft; 2 recurved spines at sides as well as pair on penis; no androconia. *P. phleophila* Barnard.
   Upper penis cover long and deeply cleft; no recurved spines at sides (pair present on penis as usual); small patch of androconia . . . . 4.
4. Strong brush of setae on claspers; spines on penis rather short (less than one-third length of upper penis cover). *P. prionii* Barnard.
   No brush of setae on claspers; spines on penis very long (as long as upper penis cover). *P. caricis* Barnard.

Larvae and Pupae of *Petroplax* species

Barnard (1934, pp. 318 and 319, fig. 13 j-q) gave brief descriptions of the larva and pupa of *P. caricis* Brnrd. These were accompanied by drawings of some of the parts, but the whole larva was not drawn. The greater part of the larval and pupal descriptions was given in the generic diagnosis, as this was the only species whose young stages were known. Thus no full description of any larva or pupa of the genus has so far been available. Since the identification of larvae and pupae without the necessity of breeding out adults is of great importance for the work of the stream survey, it seemed desirable to include a full description of the young stages of both *P. curvicosta* and *P. caricis* in this paper. In the case of *P. prionii* the description of the larva is necessarily brief as it is based on larval remains extracted from the pupal cases. Whole larvae of *P. curvicosta* and *P. caricis* were, however, available, and pupae or pupal

pelts and cases of all three species. The young stages of *P. phleophila* and *P. anomala* are as yet unknown.

The study of these additional larvae and pupae makes it desirable to amend the generic diagnosis slightly as follows:

Generic diagnosis of larva of Petroplax *Barnard* (1934, p. 316, emend.) Mandibles with internal tufts, may be feeble in left mandible. No prosternal spine. Mesonotum less strongly chitinized than pronotum, metanotum membranous. Hind leg longest. Dorsal tubercle on abdomen segment 1 obsolete.

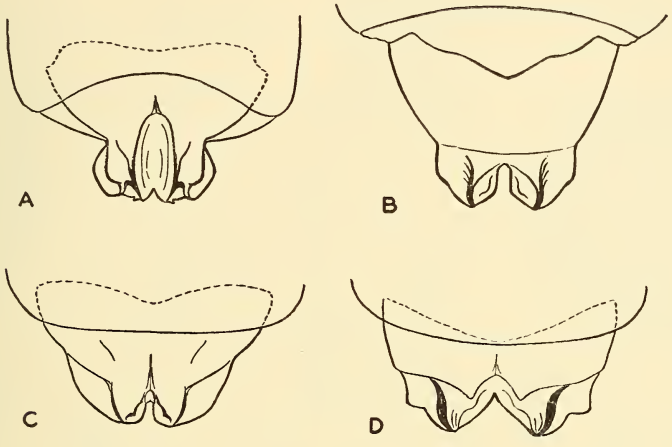

Fig. 2. Semi-diagrammatic sketches of ♀ genitalia of Petroplax spp. (Dorsal views drawn to same scale with the aid of a micrometer eye-piece.)
A, *P. caricis* Brnrd. B, *P. phleophila* Brnrd. C, *P. curvicosta* sp. n. D, *P. prionii* Brnrd.

Simple filiform gills on segments 2–8 (dorsal, lateral and ventro-lateral). Lateral line represented only by minute sclerotized tubercles on segments 3–8. Anal holdfast small. Case tubular, widening slightly towards mouth, composed of fine sandgrains with a few larger grains at one or both ends.

Generic diagnosis of pupa of Petroplax *Barnard* (1934, p. 316, emend.) Labrum nearly as long as broad, rounded. Mandible strong, serrulate on inner margin. Mid-tarsus fringed. First abdominal segment with transverse thickening, sometimes followed by a band of minute scabrosities. Simple presegmental gills present on segments 2–8 (dorsal, lateral and ventro-lateral). Lateral line present on segments 6,7,8 and posterior part of 5. Presegmental dorsal plates on segments 3–6, postsegmental also on segment 5, the latter smaller than the former. Anal appendages lanceolate, apices acute and upturned. Case somewhat similar to that of the larva, but apparently usually added to at the front and cut down at the hind end; anchored fore and aft to stones by silken threads. Membrane closing posterior end partly covered

with sand-grains and perforated by a narrow slit (the pupa lies with its ventral surface towards the concave side of the case, and the slit at the hind end is vertical, i.e. dorso-ventral). Front end of case closed by a convex lid more or less covered with sand-grains and perforated by a narrow, curved slit which lies at right angles to the one at the base.

Petroplax curvicosta sp. n.

Fig. 1 A–J.

A golden-brown species with a bend in the costa of the fore-wing and a fur-like patch of setae on the basal joint of the antenna in the male imago.

Imago (in alcohol). Characters as given in the generic diagnosis (Barnard 1934, p. 316) except as indicated above in the remarks. *Head*: face yellowish, vertex dark brown, head bearing warts from which spring long thickened yellow or brownish setae; a few of the setae are black and spine-like. Antennae annulate, brown and yellow; basal joint in ♂ broad, almost triangular in lateral view, densely clothed on three sides with a fur-like mass of stout sepia-coloured setae. *Maxillary palp* ♂ 2-jointed, setose, short and upturned; basal joint bulbous, brownish; 2nd joint very small, pale, attached to the dorsal side of the first. *Maxillary palp* ♀ 5-jointed, pale yellowish-brown. *Labial palps* pale yellowish-brown. *Thorax*: prothorax fuscous, bearing hairy warts; meso- and metathorax dark chestnut brown, shining, nearly hairless except for two pairs of raised patches in the centre of the mesothorax; membranous parts cream. *Legs*: tibial spurs 2,2,4; femora and tibiae brownish-yellow; tarsi annulate yellow and brown; tibiae and tarsi bear a number of short dark spines. *Abdomen*: tergites light sepia, sternites paler, pleura cream.

Wings: ♂ 5·5–6·5 mm.; ♀ 6·0–6·7 mm. (fig. 1 A–C). Fore-wing: membrane pale brown with darker neuration, except for costa which is white in ♂; hyaline areas indicated by dotted lines in figure (not as clear as in the other species as the membrane is paler). Wings densely pubescent. In the ♂ short thickened pale gold setae form two broad streaks, one over the cubitals, the other along the anterior border of the wing; the rest of the wing is covered with longer brown and gold hairs. Fringe brown and gold. ♀: whole fore-wing mingled brown and gold; many erect hairs on the proximal part of the wing. Pterostigma present in both sexes, also two faint white patches of hair over the hyaline areas. Hind-wings: iridescent, fuscous, thinly pubescent, with long hairs along Cu1 as far as fork and along proximal part of 1A, also a tuft at base of 1A. Fringe long. An oval bare patch at the base of M, proximal to the junction with Cu. Venation: ♂ fore-wing (fig. 1A) with costa thickened and bent near the middle; forks 1 and 2 only. ♀ fore-wing (fig. 1C) with forks 1,2,3 and (5). Hind-wings (fig. 1B) show a faint vein closing the discoidal cell, and one joining M3 + 4 and Cu1a; forks 1,2,5, present; ♂ and ♀ hind-wings similar.

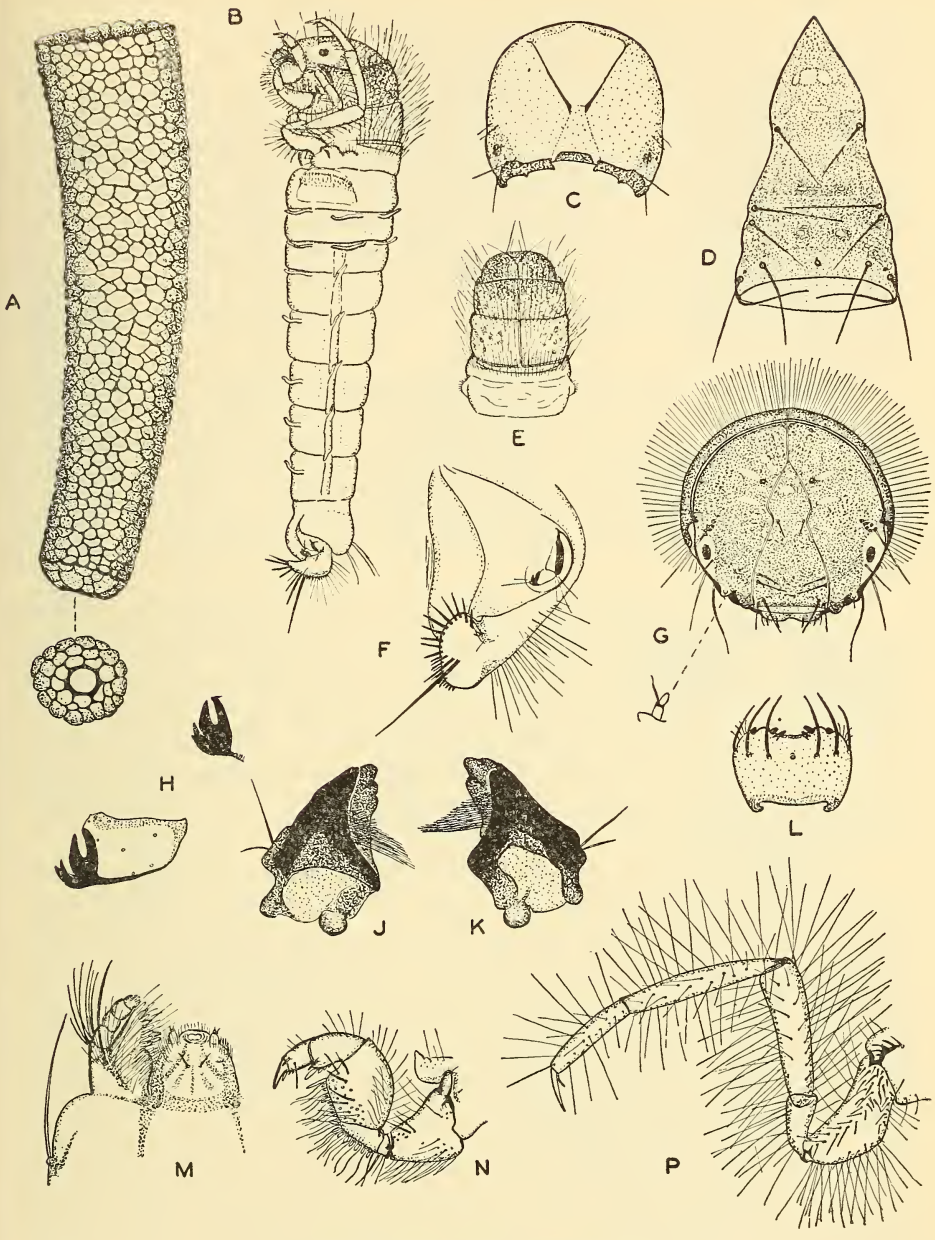

FIG. 3. Larva of *P. curvicosta* sp. n.

A, Case of larva. B, lateral view of whole larva. C, head capsule from behind, showing gular sclerite. D, clypeus and anteclypeus. E, dorsal view of anterior end of larva. F, posterior end of larva (left side). G, head and pronotum from front, with antenna enlarged. H, anal claw, showing variations. J,K, left and right mandibles. L, labrum. M, labium and maxilla. N, prothoracic leg, with plaque d'appui. P, metathoracic leg.

Genitalia: ♂ (fig. 1 D–F). Pre-anal (superior) appendages club-shaped, dark, setose; dorsal plate triangular, the apex bifid to form two short points. Upper penis cover apically slightly cleft, apices rounded; a pair of downwardly directed, recurved, strongly chitinized processes at the sides and slightly proximal to the cleft; proximal to each of these a tuft of setae. Penis with 2 long stout sub-terminal chitinized processes; tip of penis slender. Claspers (inferior appendages) with 2 branches, the upper lobate, the lower narrower, both incurved and setose. 9th sternite (ventral plate) with two long narrow processes. A spatulate ventral process on the 7th sternite, almost semicircular in shape. ♀ (fig. 1 G,H,J). Supra-anal plate cleft, lobes apically rounded and with a slight dorsal keel; cleft narrow. Vaginal structure strongly chitinized.

Locality: Great Berg River, Groot Drakenstein (A.D.H. and K.M.F.S.) November 1953, 2 ♂♂ and 4 ♀♀, bred out in laboratory from pupae collected under stones near margin out of the main current, found in the deeper pools and not in very shallow water. Also 1 ♂ imago caught in the vicinity. Larvae were collected at Groot Drakenstein and at Driefontein, higher up the Berg River; of these one larva was bred out to a ♀ imago. Imagos emerge on the surface of the water.

Remarks: In general features this species belongs to the genus *Petroplax* Barnard, but is quite easily distinguished from the other four known species. The ♂ may be identified at once by the bend in the wing and by the fur-like patch of setae on the basal joint of the antenna; the genitalia are very similar to those of *P. phleophila* but are more heavily chitinized. The ♀ genitalia show a general resemblance to those of the other species, but the four known species are easily separable by comparing the proportions of the supra-anal lobes and the width of the cleft between them. (See fig. 2 A–D.)

Larva (fig. 3 A–P): Described from entire larvae and compared with larval remains extracted from pupal cases. Larva eruciform; head hypognathous; body slightly arched; legs and thorax very hairy. Length up to 6½ mm. (pupae up to 8 mm. were however found, so that 6½ mm. is probably not the maximum length); widest at metanotum and first abdominal segment. *Head* rounded, chestnut brown in colour with a pattern of paler marks, surface of chitin pitted in places; anterior margin yellowish, ridged, the two lateral ridges each bearing a small upright antenna. Clypeus with one large and two smaller pairs of lateral indentations and 13 bristles. Eyes prominent, surrounded by pale areas. Gular sclerite triangular, fused with the genae except at the oral margin, sutures visible. *Mouthparts*: labrum with a shallow central excision and a transverse row of 6 long pale-coloured bristles; 3 pairs of blade-like bristles along the anterior margin. Mandibles each with a broad cutting-edge with 3 blunt teeth at one end; a brush of hairs on the inner side and a pair of bristles on the ridged outer side; the left mandible bears an additional central brush of short hairs. Maxilla bristly, maxillary palp 4-segmented and tipped with papillae; maxillary lobe armed with knobs and sword-shaped spines and

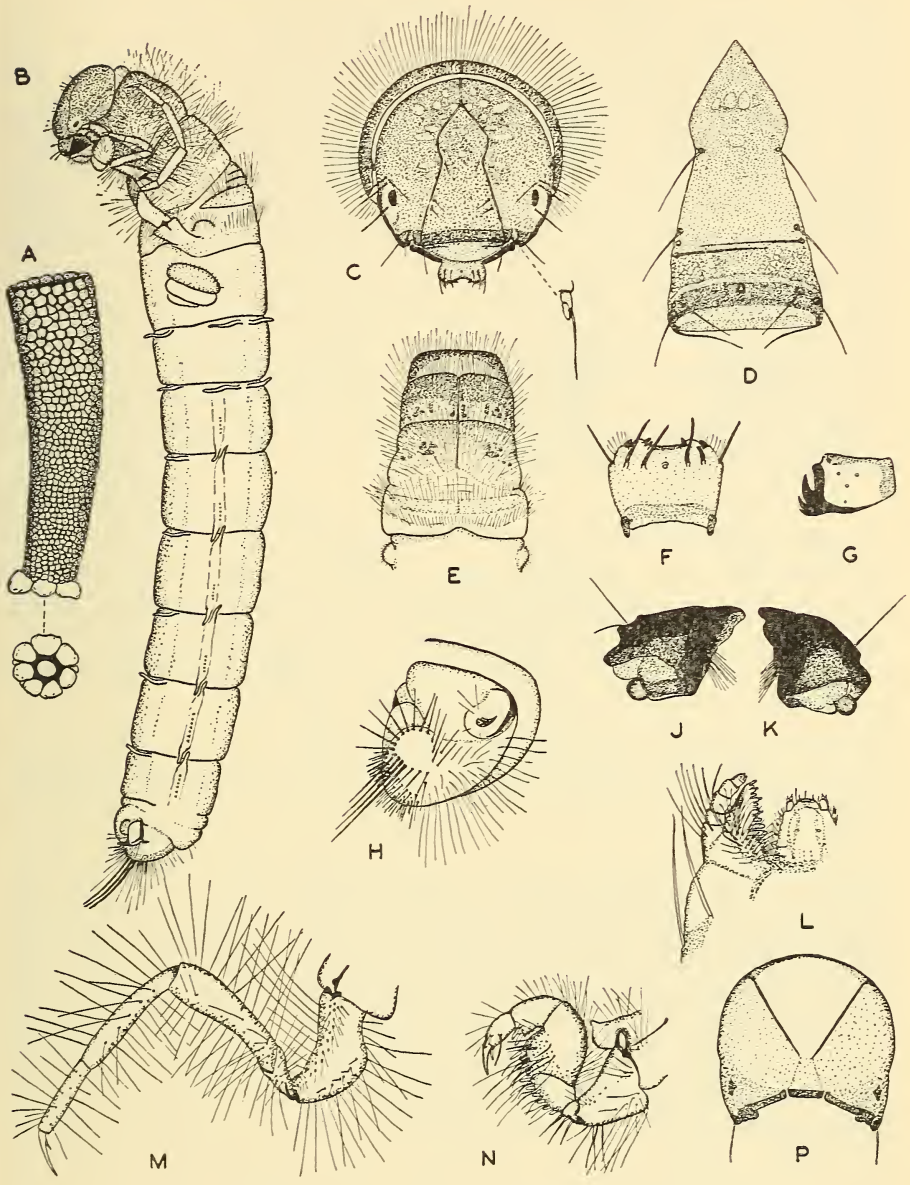

FIG. 4. Larva of *P. caricis* Brnrd.

A, Case of larva (actual size slightly longer than larva). B, lateral view of whole larva. C, head and pronotum from front, with antenna enlarged. D, clypeus and anteclypeus. E, dorsal view of anterior end of larva. F, labrum. G, anal claw. H, posterior end of larva (left side). J,K, left and right mandibles. L, labium and maxilla. M, metathoracic leg. N, prothoracic leg and plaque d'appui. P, head capsule from behind showing gular sclerite.

bristles. Labium conical, bearing 2 short palps. *Thorax*: pronotum hairy, anterior part sclerotized, chestnut-coloured, posterior part yellowish with darker chitinized spots; mesonotum hairy, only slightly chitinized, yellowish with brown spots; metanotum membranous, with a yellow transverse bar on each side of which is a row of long hairs. *Legs*: prothoracic legs short, heavily built, hairy (except tarsus), edged ventrally with strong spines; plaque d'appui oblong, truncate, with an upturned point. Meso- and metathoracic legs long, slender and very hairy, metathoracic legs longest. *Abdomen*: white; flattened lateral tubercles on segment 1. Simple filiform gills present as shown in fig. 3 B (dorsal and lateral gills on segments 2 and 3; ventro-lateral on 2–8; there also appear to be rudimentary lateral gills as shown—presegmental on segments 4–7 and postsegmental on 3–7). Abdomen ends in a pair of raised 'foot-like' oval lobes, each bearing a single long strong black spine flanked by 2 or 3 smaller ones, the 'foot' edged along the ventral and inner borders with short black spines. Anal claws with 3 barbs, the two smaller ones being variable in size.

Case: A wide curved tube neatly made of sand-grains; posterior end a truncated cone with a circular central aperture.

Pupa (fig. 6 D, G, K, N): Labrum rounded; mandibles with outer edge angular, a pair of setae near the angle; articular condyle on outer corner of base. Antennae as long as body. Each dorsal plate may bear either two or three hooks; minute scabrosities are scattered over the dorsal surface but not concentrated in any particular part. Simple pre-segmental gills present on segments 2–8 as in table I. Anal appendages fairly stout, hairy, apex short, slender and upturned, armed with several long black spines.

Case tubular, up to 8 mm. in length, neatly formed of small sand-grains, with a number of larger grains attached round each end; apertures in basal membrane and lid have serrated edges. The size and number of stones on the lid and round the ends of the case seems very variable, and several large grains may be attached round the anterior end as in *P. caricus* (fig. 6 M); the type of sand-grain used for the walls, and the shape of the slits, seem however to be constant.

TABLE I

	D	L	V
I			
II	X	X	X
III	X	X	X
IV		X	X
V		X	X
VI		X	X
VII		X	X
VIII			X

Petroplax caricis Barnard

Figs. 4 A–P and 6 A,C,F,J,M.

1934. Barnard (larva and pupa: pp. 316 and 319, fig. 13 j–q). Larvae and pupae collected by Dr. K. H. Barnard from Platteklip stream, 500 ft., Table Mountain, Cape Peninsula.

Larva: Eruciform, head hypognathous, body strongly arched; legs and thorax very hairy. Length up to 8 mm.; body widest at metanotum and 1st abdominal segment. *Head* rounded, chestnut brown in colour, patterned with paler marks, surface of chitin pitted, anterior margins dark, heavily chitinized, ridges, a small antenna on each lateral ridge. Clypeus with one pair of lateral indentations and indications of a second pair; 13 (in one case 14) bristles. Eyes prominent, surrounded by pale areas. Gular sclerite small, triangular, largely fused with the genae. *Mouthparts*: labrum with a shallow central excision, a transverse row of 6 long yellowish bristles, and 2 or 3 pairs of short peg-like

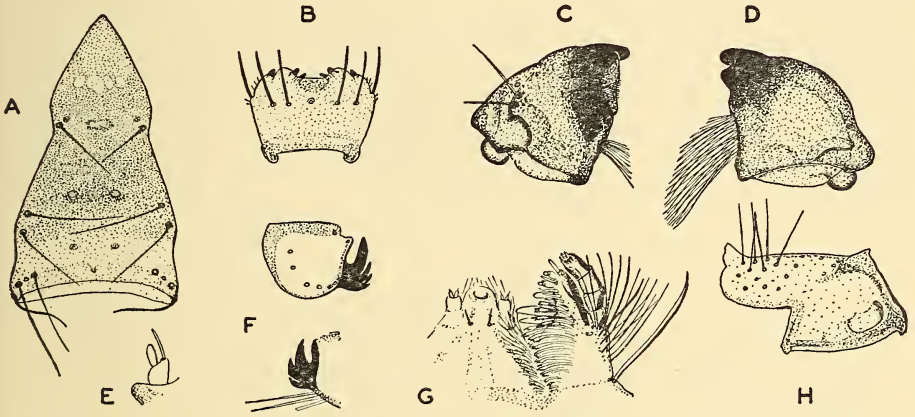

Fig. 5. Larva of *P. prionii* Brnrd.

A, clypeus and anteclypeus. B, labrum. C,D, left and right mandibles. E, antenna. F, anal claw, showing variations. G, maxilla and labium. H, plaque d'appui.

bristles along the anterior margin. Mandibles each with a broad cutting-edge rising to a single apical tooth, a short brush of hairs on the inner side (also a smaller brush on the left mandible), and a pair of bristles on the ridged outer side. Maxilla and labium similar to those of *P. curvicosta*. Thoracic nota also much as in *P. curvicosta*, but pattern of chitinized spots slightly different. *Legs* and plaque d'appui also very like those of *P. curvicosta*. Abdomen whitish, lateral protuberances on 1st abdominal segment flattened. Simple filiform gills present as shown in fig. 4 B: dorsal and lateral on segments 2 and 3; ventro-lateral on 2–8; also rudimentary lateral gills as indicated—presegmental on segments 4–8 and postsegmental on 3–7. Abdomen ends in a pair of oval lobes, each bearing a tuft of 3–4 long strong black spines, and ringed with smaller spines and hairs. Anal claws with 3 barbs (the third may be minute).

Case: A wide curved tube made of small sand-grains, with a few larger grains attached to the membrane closing the posterior end and forming a ring round a circular central aperture.

Pupa: Labrum rounded; mandibles with outer margin rounded and sinuous, ending in condyle; one pair of lateral setae. Transverse thickening on 1st abdominal segment followed by a patch of small rounded scabrosities (smaller scabrosities occur scattered over most of the dorsal surface; these are more prominent than in *P. curvicosta*). Simple presegmental gills as in table II. Dorsal plates each bear 2 hooks. Anal appendages not as stout as in *P. curvicosta*, apices short, acute and upturned, bearing a few long black spines, also smaller spines and hairs.

Case tubular, made of sand-grains of two sizes, smaller ones in the basal half and larger ones in the apical half; a number of large sand-grains attached round the posterior end partly covering the basal membrane. Lid convex and partly covered with sand-grains; apertures in lid and bottom of case have smooth edges. A few very large grains may be attached round the anterior end of the case.

TABLE II

	D	L	V
I			
II			X
III	X	X	X
IV		X	X
V		X	X
VI		X	X
VII		X	X
VIII			X

Petroplax prionii Barnard

Figs. 5 A–H and 6 B,E,H,L,P.

1934. Barnard (imago: p. 319 and figs. 14 h–l).

No identifiable larvae were included in the Berg River collection, but several pupae were collected from the Berg River at Groot Drakenstein, together with those of *P. curvicosta*, and bred out in the laboratory; the imagos which emerged (2 ♂♂, 1 ♀) were identified as *P. prionii* Barnard. Larval remains were extracted from the pupal cases and drawings (fig. 5 A–H) and the following brief description made from them.

Larva: Head sclerites chestnut brown with paler markings, area round eye pale, anterior margins yellowish; the sclerites are very similar to those of *P. curvicosta*. Small vertical antennae on the lateral ridges. Clypeus with 2 pairs of lateral indentations and 13 bristles. *Mouthparts*: labrum with a shallow central excision flanked by 3 pairs of strong blade-like setae, on the dorsal side a transverse row of 6 setae. Mandibles rather rounded, with a broad cutting edge rising to a single tooth; a slight lateral ridge flanked by a pair of setae; the left mandible with two small brushes of setae, the right mandible with one large brush. Maxilla very bristly, setae thickened and with serrated tips; maxillary palp 4-segmented and tipped with papillae; maxillary lobe with strongly developed spines of several types; labrum conical, bearing 2 short palps. *Legs*, *thoracic nota* and plaque d'appui very similar to those of the other two species. *Abdomen* appears to end in lobes studded with heavy spines and setae much as in the other species. Anal claws with 3 or 4 barbs; the smallest barb may be closely applied to the others and difficult to see.

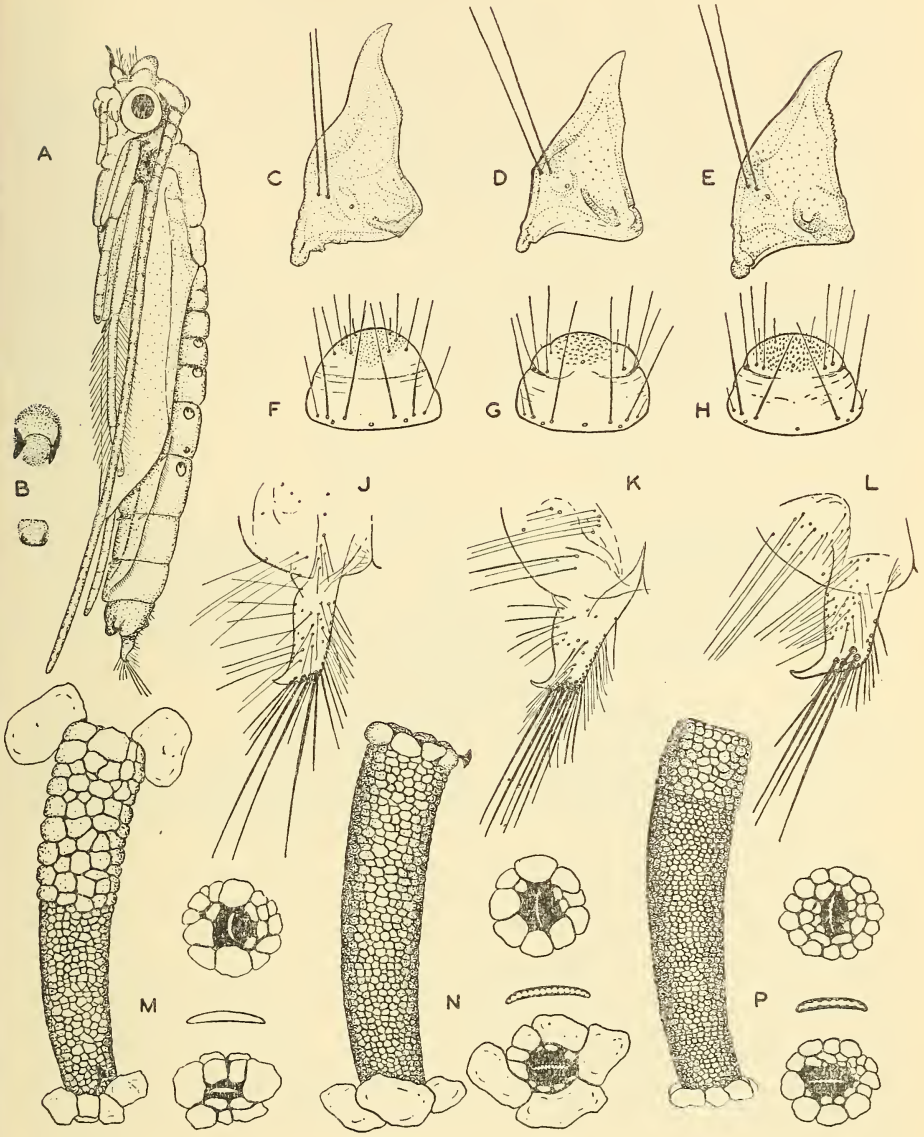

FIG. 6. Pupae of Petroplax spp. (Mandibles, labra and anal processes all drawn to same scale with the aid of a camera lucida attachment.)

A, lateral view of pupa of *P. caricis* Brnrd. B, pre- and post-segmental dorsal plates from 5th abdominal segment of *P. prionii*. C,D,E, mandibles of *P. caricis*, *P. curvicosta* and *P. prionii*. F,G,H, labra of *P. caricis*, *P. curvicosta* and *P. prionii*. J,K,L, anal processes of *P. caricis*, *P. curvicosta* and *P. prionii*. M,N,P, pupal cases of *P. caricis*, *P. curvicosta* and *P. prionii* showing also membranes from hind ends of cases, lids, and slits in lids enlarged.

Pupa: Labrum rounded; mandibles with outer margin rounded, ending in condyle, one pair of setae. Antennae as long as body. Transverse thickening on 1st abdominal segment followed by a patch of small scabrosities, smaller scabrosities scattered over the dorsal surface (these are smaller than in *P. caricis*, but larger than in *P. curvicosta*). Simple presegmental gills on segments 2–8 as in table III. Each dorsal plate normally bears 2 hooks, but occasionally one hook is double. Anal appendages stout, bearing long black spines, shorter spines and hairs. Apices acute and upturned, longer than in the other 2 species.

Case: Tubular, length up to 8 mm., neatly formed of small sand-grains, usually with a band of larger grains round the upper end; a number of large sand-grains attached to the basal membrane closing the posterior end; slit straight with crenate edges. Lid convex, made of sand-grains neatly fitted together with silk, central slit curved and with crenate edges. As in the other species several very large sand-grains may be attached round the anterior end of the case.

TABLE III

	D	L	V
I			
II	x		X
III	X	X	X
IV		X	X
V		X	X
VI		X	X
VII		X	X
VIII			X

x is rudimentary.

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